Remote-sensing supported monitoring of global biodiversity change
Remote-sensing supported global terrestrial biodiversity monitoring

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**Others:** Alberto Guzman (CSUMB), Jeremy Malczyk (Yale U), Map of Life Team (Yale, Boulder), Dave Thau (Google)
Monitoring the health of our planet

Drivers

Biodiversity

Ecosystem functions

Ecosystem services

Human well-being

Intergovernmental Platform for Biodiversity & Ecosystem Services
Monitoring the health of our planet

Drivers

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Gaps
Large conservation gains possible for global biodiversity facets
Laura J. Pollock¹, Wilfried Thuiller¹ & Walter Jetz²,³

https://mol.org/patterns/facets
Large conservation gains possible for global biodiversity facets
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Large conservation gains possible for global biodiversity facets

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in press

https://mol.org/patterns/facets

Too coarse spatial resolution!
Monitoring the health of our planet

Remote sensing

Drivers

Biodiversity

Ecosystem functions

Ecosystem services

Human well-being

Remote sensing
I. Develop, assess, use global remote sensing layers for biodiversity modeling

II. Develop informatics tools and infrastructure

III. Begin to support global monitoring
Toward a global imaging spectroscopy mission ...  

Jetz, Cavender-Bares et al. (Nature Plants 2016)
Species Distribution EBV

In prep

Country A
Country B

Climate, land cover
Prob. of occurrence | Suitability

Distribution area

Thank you!

Species Populations Working Group

Jetz et al. (MS)
Indicators

- Species protection
- Species population size
- Species range size
- Species status information
- Driver impacts on species
- Driver impacts on function
- Invasive species impact
- Ecosystem vulnerability, distribution
- Ecosystem services

Trends in

- Species populations
- Community composition
- Species traits
- Ecosystem structure
- Ecosystem function

Ancillary Data

- Species invasive impact
- Species abundance
- Species life history
- Species traits
- Species relevance for ES function, services

In prep

Species Populations Working Group

Species Distribution

EBV

GEO BON

Species Populations Working Group
Daily, 1km cloud cover


Adam Wilson
Yale, U Buffalo

A Cloud Atlas Provides Clues to Life on Earth
A multi-decadal time series of 1km daily temperature

- MODIS cloud mask and LST data + met station data

Benoit Parmentier
Daily, 1km temperature

Data Partitioning

Meteorological Station Database

Elevation

LST MOD11A2

Validation Dataset

Training Dataset

Monthly Dataset

Difference

GAM

Kriging

Monthly Climatology

Sum

Daily Deviation

Daily Prediction
Daily, 1km temperature

IMPLEMENTATION on NEX

- Stage 1: MODIS global climatology Averaging and Gap filling
- Stage 2: Covariates production by tiles
- Stage 3: Database Query and Covariates extraction for meteorological stations
- Stage 4: Daily Predictions by tiles
- Stage 5: Assessment by tiles And Regions
- Stage 6: Gap detection and regional mosaicing
- Stage 7: Global Mosaicing Temperature predictions RMSE, N stations, residuals

- 300 TB of total output data
- 60 TB for 30-year data record of global, 1km, daily mosaics for Tmax and Tmin
- 300,000 SBUs (~3.6 million CPU hours)

Technically, computationally comparable to MEaSUREs projects
Daily, 1km temperature

Stage 1
MODIS global climatology
Averaging and Gap filling

Stage 2
Covariates production by tiles

Stage 3
Database Query and Covariates extraction for meteorological stations

Stage 4
Daily Predictions by tiles

Stage 5
Assessment by tiles And Regions

Stage 6
Gap detection and regional mosaicing

Complete

Note: Hardware failure at NAS in January 2017 resulted in loss of 50TB of data; reprocessing completed on NEX in ca. 2 months

Stage 7:
Global Mosaicing
Temperature predictions RMSE, N stations, residuals

Ongoing

Technically, computationally comparable to MEaSUREs projects
Observed vs. EarthEnv Predicted

Spencer, Massachusetts
1999

Maximum Daily Temperature
Spencer, Massachusetts

Daily, 1km temperature
Daily, 1km temperature

- MODIS cloud mask and LST data + met station data
- RMSE: ~2.5°C

19840101

Daily Maximum Temperature, 1984
II. Develop informatics tools

Map of Life (MOL) is an initiative that aims to "putting biodiversity on the map". It provides access to 279 datasets containing information on 844,971 species and 555,744,036 records. The platform offers a one searchable map with tools for mapping species, species by location, indicators, and a mobile app for discovering, identifying, and recording biodiversity worldwide.
Biodiversity data $\cap$ Environmental data

Not trivial …
Species range predictions

Wilson & Jetz 2016
III. Begin to support global monitoring

Trends in biodiversity knowledge, distribution, and conservation

- **Species Data Coverage**: View spatial and temporal gaps in biodiversity data
  - Explore

- **Species Habitat**: Explore species habitat suitability
  - Explore Preview

- **Species Protection**: Explore species reserve gaps
  - Explore Preview
Thanks ...!

Yale Center for Biodiversity and Global Change

Launching this fall:
Max Planck – Yale Center for Biodiversity Movement and Global Change